SOUTHWEST FISHERIES CENTER
HONOLULU LABORATORY
2570 DOLE STREET
HONOLULU, HAWAII 96822-2396
NATIONAL MARINE FISHERIES SERVICE

March 1987

A REPORT ON RESIDENT FISHING IN THE HAWAIIAN ISLANDS

Developed by

Meyer Resources, Inc.
Davis, California

ADMINISTRATIVE REPORT H-87-8C

Southwest Fisheries Center Administrative Report H-87-8C

A REPORT ON RESIDENT FISHING IN THE HAWAIIAN ISLANDS

Developed by

Meyer Resources, Inc.
Davis, CA

March 1987

PREFACE

This is the final report on a project to determine the economic value of recreational fishing in Hawaii. The study was undertaken because of the need by fisheries managers for information on the value of recreational fisheries as well as commercial fisheries, and because of the intrinsic interest of the subject. The project was funded by the Southwest Fisheries Center economic research program as NOAA Contract 84-ABC-00105.

The question of measuring the economic value of resources which are not sold in markets, such as recreational fish, is a difficult conceptual and practical problem. This is particularly difficult in Hawaii where there is no clear delineation between commercial and recreational fishing. Meyer addresses these issues in the context of introducing the project design and in discussing the results.

Meyer's research approach involves a number of items which are relatively unique to Hawaii. These include the use of the "key respondent" technique for estimating values for recreational fishers and the use of the "fair value" concept in economic valuation. Discussion of these techniques is a part of this project.

Meyer finds the total non-market value of recreational fishing (from boats) in Hawaii to as much as $239 million from direct expenditures of $24 million. Sales of fish by "recreational" fishers is estimated at 10 million pounds, valued at $22 million, and total catch by recreational fishers is estimated at 21 million pounds. These are substantial numbers for Hawaii, especially when compared to recorded commercial fish landings of 8.4 million pounds in 1985, worth $16.7 million. Meyer points out that the basis for these average values and their extrapolation is tentative and subject to further investigation. Readers will want to scrutinize the methodology used by Meyer and other researchers in developing catch numbers and economic values for fisheries in Hawaii but we believe this report is an important contribution to understanding the tremendous value placed on "recreational" fishing by people in Hawaii.

This report was prepared under contract. Therefore the statements, findings, conclusions and recommendations are those of Meyer Resources Inc. and do not necessarily reflect the views of the National Marine Fisheries Service.

Samuel G. Pooley
Industry Economist

A Report on Resident Fishing in the Hawaiian Islands

Developed for:

National Marine Fisheries Service,

Honolulu, HI

Contract No. 84-ABC-00105

Developed by:

Meyer Resources, Inc.

Davis, CA.

March, 1987

Table of Contents

Table of Contents (cont)

List of Tables

List of Tables (cont'd)

List of Tables (cont'd)

I. Objective of the Report

The principal objective of this report is to assemble available information on the economic significance, in both market and non-market terms, that residents of Hawaii associate with non-commercial fishing. Market value refers to circumstances where catch is exchanged for dollars in either formalized or non-formalized transactions--as well as to the expenditures a fisherman associates with his or her fishing activity. Non-market value refers to the worth that fishermen associate with their activity over and above dollars received or spent. The term "resident fisherman" refers to persons who are not making their primary living from commercial fishing. In other jurisdictions, such persons might be described as recreational fishermen. In the Hawaiian Islands, however, any citizen may purchase a license for five dollars, enabling him/her to sell fish. This makes a sharp distinction between recreational and commercial fishing less meaningful. The resident fisherman, as defined here, will fish for enjoyment, own consumption, to obtain cash to defray boat expenses, and for a variety of other purposes, but not to obtain his or her primary source of income.

Several secondary objectives are also considered in this report.

- -- identification of the satisfactions residents of the Hawaiian Islands associate with fishing;
- -- identification of the variety of uses to which catch is put;
- -- identification of accessing points (ie. harbors and ramps);
- -- estimation of catch by species;
- -- estimation of effort;
- -- identification of fishermen attitudes and perceptions related to boating facilities and a range of other fish/boating issues in Hawaii.

This report targets information on resident fishing from four islands, Oahu, Hawaii (hereafter, the Big Island), Maui and Kauai, comprising over 99 percent of the State's population.

II. Information Development Procedures

A reasonably accurate data set is available on vessel ownership in the Hawaiian Islands[1]. Further, Samples, et. al. have developed data on Hawaii's charter fishing fleet[2], while SMS Research conducted some exploratory work in valuing resident boater fishing[3]. However, no comprehensive, statistically integrated, data set from which to derive targeted resident fishing values exists for resident fishermen in the Hawaiian Islands.

The initial project outline called for a detailed and extensive mail survey of boat fishermen in Hawaii. However, because of constraints imposed on the project design, this objective could not be fulfilled. Therefore, it was determined to utilize an expanded "key respondent" technique to develop the information we sought, and to backcast where possible to compare the key respondent information to that previously existing. Key respondents are often used to obtain information in anthropological and social scientific enquiries.

---

1. State of Hawaii, Department of Transportation.

2. Samples, Karl C., J.M. Kusakabe and J.T. Sproul, A Description and Economic Appraisal of Charter Boat Fishing in Hawaii. Southwest Fisheries Center Admin. Report H-84-6C, Honolulu, April, 1984; Samples, Karl C. and D.M. Schug, Charter Fishing Patrons in Hawaii: A Study of Their Demographic Motivations, Expenditures and Fishing Values, Southwest Fisheries Center Admin. Report H-85-8C, Honolulu, May, 1985.

3. SMS Research, Experimental Valuation of Recreational Fishing in Hawaii. Southwest Fisheries Center Admin. Report H-83-11C, Honolulu, June, 1983.

Zelditch suggests that key respondent procedures often prove sufficiently reliable to approximately replicate results from survey sampling--particularly for questions involving enumeration, or for those concerning what people do now, or did in the past[4]. Following Zelditch, this type of information, provided by key respondents, is not just individual opinion, but is in some sense an objective measure of group values. However, he adds, eliciting information about key respondents themselves is a suspect way of using the key respondent procedure, unless the key respondents can be seriously thought of as representatives of their group.

With the above concerns in mind, the following procedure was used to develop information for the present analysis.

1. Fishing clubs on the four main Hawaiian Islands were identified and their Presidents were contacted during the last quarter of 1985.
2. A meeting was held with each President, and usually one or two other club members. At the meeting, information sought for this report, and issues and concerns of club members were discussed.
3. On the basis of (2) above, and after consultation with NMFS, a discussion outline was prepared. This outline was constructed to provide a balance of principal topics between what Meyer Resources, Inc. (MRI) wished to talk about, and what each fishing club wanted to talk about. The discussion list is presented on the next page (Table 1).

---

4. Zelditch, Morris Jr. "Some Methodological Problems of Field Studies" in Franklin and Osborne (eds), Research Methods: Issues and Insights. Wadsworth Publishing Co. Belmont, CA, 1971, pp. 228-244.

Table 1

Discussion Outline for Club Meetings

MRI Topics	Fishing Club Topics
- Dollars spend on fishing	- Facilities needed at launching ramps
- Value of an hour's fishing over and above expenses	- Facilities needed at harbors
- Description of the fishing trip	- Fueling facilities required in the Islands
- Disposition of catch	- Fishing methods that should not be allowed
- Description of catch	- Opinions on whale sanctuaries
- Reasons for fishing	- Facilities and issues re. shore fishing

4. Mr. Meyer was then invited as the "entertainment" at a regular meeting of each fishing club. Somewhere between 6 and 30 members or guests were usually present. Each issue was discussed, with those members who wished to, writing opinions and information on an accompanying discussion guide. In some instances, information was sent to MRI by club members subsequent to the meeting. Information gathered referred to the 1985 fishing year. This task was accomplished in the January through March period, 1986.
5. MRI then integrated the information received, subjected it to an initial computer analysis, and printed out "results" for each topic of interest.
6. In the last quarter of 1986, MRI then sent the information derived from each club back to the club, to verify that it was "representative".

7. Follow-up communication ensued, and information developed in the initial key respondent round of discussion was adjusted where required. Steps (6) and (7) thus fulfilled the conditions for "representativeness" outlined by Zelditch (pg. 3).

In this manner, "representative" information was developed for 15 boat fishing clubs and two shore fishing clubs on the 4 main Hawaiian Islands. A listing of these clubs follows (Table 2). Nine persons with no club affiliation, and fishing the windward side of Oahu also responded to the issues identified. Two clubs, Pokai Bay on Oahu and Kona Iki, on the Big Island, invited me to a meeting--but not enough information was obtained to have confidence in the representativeness of results. The Maui Coop. is primarily a club for commercial fishermen. Information from that club is included in most tables, but is not integrated into Maui or statewide totals, except where considered appropriate.

Table 2

Responding Fishing Clubs - Hawaiian Islands

Island	Club	Main Type of Fishing
Oahu	Aiea	Boat fishing
Oahu	Haleiwa	Boat fishing
Oahu	Honolulu Mosquito Trollers	Boat fishing
Oahu	Kaneohe	Boat fishing
Oahu	Keehi	Boat fishing
Oahu	Pearl Harbor	Boat fishing
Oahu	Waialua	Boat fishing
Big Island	Hilo Casting	Shore fishing
Big Island	Hilo Trollers	Boat fishing
Big Island	Kona Casting	Shore fishing
Big Island	Kona Mauka	Boat fishing
Maui	Maalaea	Boat fishing
Maui	Maui Coop.	Boat fishing
Kauai	Kukuiula	Boat fishing
Kauai	Westside Commercial and Sport Fishing Club	Boat fishing

III. Representativeness of Information Developed

As noted, under the key respondent procedure adopted here, we are reasonably confident that information received is representative on a fishing club by club basis. Two broader questions remain. First, can the information received be considered representative of all fishing clubs on a broader island by island basis, or across the State of Hawaii? Second, is information developed from fishing clubs members representative of resident fishermen in the Hawaiian Islands as a whole? Differences in informational results might be expected on the basis of geographic location, income, age or a variety of other demographic characteristics. It must be emphasized, however, that differing status between fishing sub-groups is not, in itself, sufficient to indicate differences in information response. Rather demographic or other sub-group characteristics must also "predict" with respect to information received.

Sufficient information exists to evaluate demographic differences between clubs, and, because of the single island constituency of each club, between islands[5]. Only limited data exists, however, describing the characteristics of boat and shore fishermen as a whole in the Hawaiian Islands. Discussion of potential representativeness with respect to the boat fishing/shore fishing population in general must therefore proceed inferentially. These issues will be considered further during presentation and discussion of informational results.

---

5. Skillman, Robert A. and David K.H. Louie, Inventory of U.S. Vessels in the Central and Western Pacific. Southwest Fisheries Center Administrative Report H-84-12, NMFS. Honolulu, 1984, suggest that approximately 11 percent of fishermen in the Hawaiian Islands belong to clubs.

IV. Presentation and Discussion of Information

1. Introduction

Because the information presented here is developed by aggregating individual perceptions of several club members into a "club representative" information set, information aggregation procedures are not always obvious. In some cases, it will be most efficient to rely on the information provided by individual key respondents. In other instances, "by club" analysis will seem more reliable. Further, aggregation choices are available at club, island and state of Hawaii levels. It will consequently be necessary to consider aggregation choices for each informational characteristic discussed in this report. While available information will vary across topics discussed, basic choices are outlined in Table 3.

Table 3

Basic Representative Information Units
Available as a Basis for Analysis

Aggregation Designation	Units of Information Available By Club	By Island	By State
A. Oahu			
Pearl Harbor Club	6		
Haleiwa Club	5		
Aiea Club	16		
Waialua Club	31		
Keehi Club	22		
Kaneohe Yacht Club	22		
Honolulu Mosquito Club	16		
Pokai Bay(1)	2		
Oahu - at large fishermen	9		
All Oahu boat fishermen		129	
All Oahu boat clubs		7	
B. Big Island			
Hilo Casting Club	16		
Kona Iki Club(1)	1		
Hilo Trollers Club	25		
Kona Mauka Club	8		
Kona Casting Club	13		
All Hawaii Boat fishermen		34	
All Hawaii Shore fishermen		29	
All Boat Clubs		2	
All Shore Clubs		2	

(cont'd on pg. 9)

Table 3 (cont)

Aggregation Designation	Units of Information Available		
	By Club	By Island	By State
C. Maui			
Maalaea Boat Club	31		
Maui Fisherman's Coop	10		
All Maui Boat Fishermen(2)		31	
All Maui Boat Clubs(2)		1	
D. Kauai			
Kukuiula Club	14		
Westside Club	10		
All Kauai Boat fishermen		24	
All Kauai Boat clubs		2	
E. State of Hawaii			
All boat fishermen			218
All shore fishermen			29
All boat clubs			12
All shore clubs			2

(1) Not enough information was developed to support analysis.

(2) The Maui Coop. is extensively involved in commercial fishing. It is described in this report, but "resident fishing" results for the island of Maui are based on the Maalaea Club only.

2. Expenditures by Resident Sport Fishermen in the Hawaiian Islands

a) Boat Fishing

i) Information at the Club Level

Boat fishing costs per trip were developed by expense item for each club, and then added to a total. Amortization of the boat was not included. Individual response data was quite limited for some clubs (see Table 3), so that, in those cases, 95 percent confidence intervals for itemized expenses sometimes encompassed zero. On this basis, it was concluded that reporting of individual expense items, by club, would not be reliable. Our follow-up procedure with clubs did, however, indicate that the "total expenses" information we developed was likely "representative" for each club. This information is indicated in Table 4.

Table 4

Total Expenses per Boat Fishing Trip, By Club
Resident Hawaii Fishermen

Club	Estimated Total Expenses per Trip $
A. Oahu	
Aiea	97.76
Haleiwa	118.40
Honolulu Mosquitos	129.45
Kaneohe	105.58
Keehi	128.11
Pearl Harbor	107.40
Waialua	85.39
B. Big Island	
Hilo Trollers	134.47
Kona Mauka	111.15
C. Maui	
Maalaea	187.28
Maui Coop(1)	178.82
D. Kauai	
Kukuiula	106.50
Westside	125.33

(1) Primarily a commercial fishing group.

This information suggests relatively little difference in total boat fishing costs between clubs, although boat fishers on Maui may spend more than elsewhere. Results for the 9 "at large" fishermen we talked to on the windward side of Oahu were lower, averaging out at $67 per trip. We have no method of assessing what sub-group, if any, these results are representative of, and will not use them further in analysis.

ii) Information at the Island Level

To make any reliable, by island comparisons, information needs to be further analyzed. Table 5 identifies cost expense information, by island and by item. As the Maui Coop is essentially a commercial fishing group, only Maalaea data is used for Maui. Based on the key respondent information provided, both mean values and standard deviations are provided. Ninety-five percent confidence intervals for each mean are provided beneath each mean in parenthesis, rounded to the nearest dollar. It can be observed that aggregation of club information makes resulting expenditure estimates appear more reliable. Such aggregation is most noticeable for data from Oahu and Hawaii. As information from only one fishing club was used on Maui, aggregation had no effect there.

Table 5

Total Expenses Per Boat Fishing, Trip, by Island
Resident Hawaii Fishermen

Boat Fishing Expense Item	Oahu Mean Expense	Oahu Standard Deviation	Big Island Mean Expense	Big Island Standard Deviation	Maui[1] Mean Expense	Maui[1] Standard Deviation	Kauai Mean Expense	Kauai Standard Deviation
	$		$		$		$	
Fishing Gear	22.54 (+/- 6)	32.29	29.26 (+/- 11)	30.90	28.71 (+/- 17)	40.36	18.42 (+/- 8)	17.54
Food & Beverages	13.80 (+/- 2)	8.26	16.06 (+/- 3)	9.35	33.19 (+/- 15)	35.44	12.47 (+/- 5)	11.97
Ice	9.79 (+/- 2)	12.78	8.74 (+/- 2)	5.94	26.19 (+/- 28)	64.49	10.05 (+/- 6)	12.83
Bait	7.02 (+/- 2)	8.29	10.66 (+/- 3)	8.85	9.24 (+/- 7)	16.40	10.42 (+/- 9)	18.95
Boat Fuel	39.39 (+/- 5)	29.43	57.44 (+/- 11)	31.81	65.43 (+/- 48)	111.13	40.79 (+/- 7)	31.95
Car Fuel	7.01 (+/- 1)	6.81	7.69 (+/- 2)	4.45	18.90 (+/- 28)	65.00	9.16 (+/- 6)	13.47
Other	4.38 (+/- 2)	9.94	5.00 (+/- 2)	10.68	5.62 (+/- 5)	12.11	14.11 (+/- 15)	32.25
Total Expense	$103.93		$134.85		$187.28		$115.42	

(1) Based on Maalaea only.

* (+/-) indicates the range of the 95 percent confidence interval.

iii) Information at the State Level

Aggregation of information on a state-wide basis is presented in Table 6. Again, mean values, associated standard deviations and confidence intervals are provided.

Table 6

Total Expenses Per Boat Fishing Trip - State of Hawaii Resident Fishermen

Expenses Item	Mean Value $	Standard Deviation $
Fishing Gear	23.96	33.13
Food and Beverages	16.27	15.68
Ice	11.52	25.11
Bait	8.26	11.06
Boat Fuel	45.65	18.30
Car Fuel	8.71	23.80
Other Expenses	5.64	14.36
Total Expenses	$120.01	

iv) Comparison with Other Expenditure Data for Boat Fishermen

SMS Research reported 1983 average per trip costs of $104, based on random sampling of persons launching trailered boats at Waianae (Pokai Bay) Small Boat Harbor[6]. This result, which did not segregate boating club members from non-club members, included a $12 dollar per trip boat amortization item, not incorporated in our 1986 results. However, considering the passage of 3 intervening years, and the $104 per trip expense reported for Oahu in Table V of this report, results seem closely analogous.

---

6. SMS Research, op. cit.

v) Conclusions Concerning Expenses per Resident Boat Fishing Trip in the Hawaiian Islands

On the basis of the previous discussion and reported results, it is our impression that the expenses identified in Table 4 are likely "representative" at club levels. Further, comparison of Oahu total expense estimates with those from SMS, seems to support a tentative hypothesis of no significant difference in per trip expenses between boat fishing club members and non-club members in the Hawaiian Islands. We consequently believe that Tables 5 and 6 also present estimates of per trip expenditure that are improved over those previously available. While we are fairly confident with respect to these data, expenses per trip do differ somewhat by island, and by club sub-group.

b) Shore Fishing

As noted, information on shore fishing was only developed for the Big Island. Estimated expenses per trip, based on discussion with two Big Island shore fishing clubs, is presented in Table 7.

Table 7

Estimated Shore Fishing Expenditures on the Big Island

Expense Item	Expenditures per Trip	
	Hilo Casting $	Kona Casting $
Transportation	25.14	10.27
Ice	4.71	10.00
Bait	5.71	4.00
Fishing Gear	21.62	15.00
Food and Beverages	27.81	20.00
Other Expense	5.24	.45
Total Expense	$90.23	$59.72

These data are limited. Estimates between clubs diverge, and may represent a range of possible shore fishing expenditures over trips with varying characteristics. As might be expected, however, shore fishing costs are less than those developed for boat fishing.

3. The Non-Market Value of Resident Sport Fishing in the Hawaii Islands

a) Discussion of Concepts

As noted, in Section I, the value of recreational fishing to participants often exceeds what they actually pay. This is due to a number of factors. Market prices may not be structured to capture every last cent each participant would be willing to pay to fish, and do not adequately indicate compensation participants would consider fair if fishing opportunity was preempted; fishermen may live close to the fishing site, so that travel costs are minimal; expenditures don't capture the value of time expended in going fishing, and so on. Thus, market value does not equal total value for fishing, and an additional component, termed "non-market value" must be added in if the values of fishermen are to be fully represented.

Failure to consider additional non-market values in resource decision-making will distort results in a number of ways. First, the benefits associated with facilities supporting resident fishing will be understated, relative to their costs of construction and operation. Second, the value of protecting and enhancing fisheries will be underestimated, relative to competing activities that primarily produce products valued in the economic market place. Third, failure to adequately consider non-market values will direct fishing programs toward generating dollar returns and away from the enhancement of non-dollar public benefits. In the Hawaiian Islands, where access to marine fishing has traditionally been

free, these are significant concerns. It is consequently necessary to estimate both market and non-market values associated with resident fishing.

Economists typically estimate non-market values by attempting to simulate what would occur if there was an economic market that extracted all the value from resident fishermen. Markets are created when buyers who will purchase various amounts of goods or services at each of a series of possible prices (in geometric terms, the demand curve) interact with sellers, who will sell various amounts of goods or services at each of a series of possible prices (the supply curve). The lower the price, the more people will want to buy the good. The higher the price, the more people will be willing to sell it. At some point, exactly the same number of buyers and sellers will interact at a single price, determining both market price and market quantity. This is the process that economists working in the non-market area set out to simulate.

The majority of traditional market simulations have focussed on specification of the demand for fishing. Such specification has involved two general lines of inquiry, direct questioning of what respondents might be <u>willing to pay</u> for fishery benefits, or estimates of the relationship between expenses actually incurred and participation in fishing. The former direct procedures are most often characterized as "willingness to pay", the latter as "travel cost", or some augmented variant such as hedonic evaluation. According to economic theory, valuation of fisheries based upon simulated

demand is clearly most appropriate when considering an increase in welfare due to enhanced fishery benefits[7]. Such enhanced benefits may occur as the result of an overall improvement in fishery stocks, where, presumably, all user groups may benefit to some degree, or from the reallocation of existing stocks from users of lower value to users of higher value. In the latter case, and without establishment of a property right, it has been traditional in economic theory to consider all user groups as bidders, with allocation decisions based on highest valued use or uses.

Significant advances have been made in both direct and indirect estimation of demand curves applicable to non-market fishery (and wildlife) benefits. Early direct willingness to pay work in the Pacific Northwest was conducted by Hammack and G. Brown, Jr.[8], by G. Brown, Jr., Charbonneau and Hay[9], and by Crutchfield and Schelle[10]. Further important improvements in bias management associated with direct simulation of non-

---

7. A general discussion of welfare criteria associated with gainers and losers affected by reallocation of resources may be found in H.H. Liebhafsky, The Nature of Price Theory, Chapt. 16. Dorsey Press, Homewood, ILL. 1963.

8. J. Hammack and G.M. Brown, Jr., Waterfowl and Wetlands: Toward Bioeconomic Analysis. Baltimore: John Hopkins Press, 1974.

9. G.M. Brown, Jr., J.J. Charbonneau and M.J. Hay, Estimating Values of Wildlife: Analysis of the 1975 Hunting and Fishing Survey, Working Paper No. 7, U.S. Fish and Wildlife Service, 1978.

10. J.A. Crutchfield and K. Schelle, An Economic Analysis of Washington Ocean Recreational Salmon Fisheries with Particular Emphasis on the Role Played by the Charter Vessel Industry. U. of Washington, Dept. of Economics, Seattle, 1979.

market values have been achieved, particularly at the Universities of Wyoming and Wisconsin[11].

Indirect valuation of non-marketed resources has also improved substantially in the past two decades, via travel cost and augmented travel cost approaches, including hedonic evaluation of fisheries. W.G. Brown, et.al. reported travel cost work in the Pacific Northwest as early as 1964[12], and has published a number of travel cost and augmented travel cost evaluations since[13]. Donnelly, Loomis and Sorg[14] have also developed recent data for Idaho using both direct and indirect evaluation methods. G.M. Brown, Jr. reported on hedonic

---

11. For a review of this work, see R.G. Cummings, D.S. Brookshire, W.D. Schulze and D.L. Coursey, Valuing Environmental Goods: A State of the Arts Assessment of the Contingent Valuation Method. Rowman and Allanheld, Totawa, N.J., 1986.

12. W.G. Brown, A. Singh and E.M. Castle, An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery, Oregon Agricultural Experiment Station Technical Bulletin 78, Corvallis, Ore. 1964.

13. W.G. Brown, D.M. Larson, R.S. Johnston and R.J. Wahle, Improved Economic Evaluation of Commercially and Sport-Caught Salmon and Steelhead of the Columbia River, Oregon Agricultural Experiment Station, Corvallis, Ore. 1976; W.G. Brown, C. Sorhus and K.S. Gibbs, Estimated Expenditures by Sport Anglers in the Pacific Northwest, Department of Agricultural Resource Economics, Oregon State University, 1980; W.G. Brown, C. Sorhus, B. Chou-Yang and J. Richards, "Using Individual Observations to Estimate Recreational Demand Functions: A Caution", American Journal of Agricultural Economics, Vol. 65, No.1, Feb. 1983, pp. 154-157; P.A. Meyer, W.G. Brown and C. Hsiao, An Updating Analysis of Differential Sport Fish Values for Columbia River Salmon and Steelhead, a report to NMFS, Portland, June, 1983.

14. D. Donnelly, J. Loomis and C. Sorg, The Net Economic Value of Recreational Steelhead Fishing in Idaho, Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service, Fort Collins, September, 1983.

evaluation of Northwest fisheries, using a travel cost based technique in 1978[15], and again in 1981[16].

Reviewing these studies, and others, it can be concluded that methods for simulating demand curves for non-market goods and services, via either direct procedures or by indirect travel cost based procedures, are well advanced--and that choice of procedure will likely not be determined by relative theoretical soundness, but by applied circumstance. Indirect methods for simulation of demand curves avoid strategic behavior potentially displayed by respondents when hypothetical questioning is employed. However, demand estimation based on travel cost will not provide a fully comprehensive estimate of fishery values where fishermen's homes are too close to fishing destinations, so that travel cost becomes a poor indicator of relative value and of participation. This is believed to be the case in Hawaii[17]. Here, one can predict that travel cost based demand curve estimates that focus on residents of coastal areas and consider nearby marine fisheries will produce lower value estimates than studies of residents in areas where source/destination separation is likely greater and more distinct.

---

15. G.M. Brown, Jr., Valuation of Non-market Natural Resources with a Hedonic Technique. Univ. of Washington, Seattle, 1978.

16. G.M. Brown and R. Mendelsohn, The Hedonic Travel Cost Method: A New Technique for Estimating the Recreational Value of Site Characteristics, A report to the U.S. Dept. of Interior, University of Washington, Seattle, 1981.

17. SMS Research, op. cit.

Just as non-market economic methodology requires simulation of demand curves to evaluate fishery improvements, it is equally clear that economic theory requires simulation of supply curves to estimate the value of fishery losses[18]. The earliest willingness to sell (compensatory) estimate for salmon and steelhead was estimated by Mathews and Brown in 1967 in the Pacific Northwest[19]. More recently, Crutchfield and Schelle[20] (1979) produced a compensatory estimate for Washington state sport fishing, while Meyer Resources (1980; 1982) developed a compensatory estimate for selected groupings of fish and wildlife in California's Central Valley[21], and a similar estimate for upper Columbia River salmon and steelhead[22]. Ownership rights in fisheries further strengthen the rationale for compensatory evaluation. In the Pacific Northwest, Indian fishery rights

---

18. W.K. Desvouges, V.K. Smith and M. P. McGivney, A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements. Research Triangle Institute, Triangle Park, N.C. EPA Contract No. 68-01-5838, 1983; D.H. Huppert, NMFS Guidelines on Economic Evaluation of Marine Recreational Fishing. NOAA Technical Memorandum NMFS-SWFC-32, June, 1983. The Bay Institute of San Francisco, Proceedings of a Workshop on Economic Non-Market Evaluation of Losses to Fish, Wildlife and Other Environmental Resources, (forthcoming).

19. S.B. Mathews and G.S. Brown, Economic Evaluation of the 1967 Sport Salmon Fisheries of Washington. Technical Report No. 2, Washington Department of Fisheries, Olympia, 1970.

20. J.A. Crutchfield and K. Schelle, op. cit.

21. P.A. Meyer, Recreational/Aesthetic Values Associated with Selected Groupings of Fish and Wildlife in California's Central Valley. A Report to the U.S. Fish and Wildlife Service, Center for Natural Areas, Sacramento, CA. 1980.

22. Meyer Resources, Inc. Recreational/Aesthetic Values Associated with Salmon and Steelhead of the Columbia River, A Report to the U.S. Bureau of Indian Affairs, Portland, May, 1982.

provide an obvious example[23]. Further, state agencies with restoration responsibilities for fish and wildlife have successfully recovered compensatory damages for losses caused by pollution[24]. Finally, recent adjudication of the Mono Lake case in California, referencing doctrine of the Public Trust, assigns public rights to natural resources co-equal importance with private rights[25].

Compensatory evaluation to date has proceeded via direct hypothetical questioning, and consequently may be subject to respondent biassing concerns. As with direct estimation of demand, however, work by a number of economists provides a useful array of bias management techniques that are available to the economic analyst[26]. Consequently, while fewer compensatory studies have been done, and while direct willingness to pay questioning may elicit some downward bias while direct willingness to sell (ie. compensatory) questioning may elicit some upward bias, techniques for bias reduction can now contain such distortion to the point where direct estimation of fishery values can be usefully applied for a range of purposes.

---

23. U.S. District court, United States v. Washington, filed in Tacoma, Sept. 18, 1970.

24. F. Halter and J.T. Thomas, "Recovery of Damages by States for Fish and Wildlife Losses Caused by Pollution", Ecology Law Quarterly, Vol. 10-5, 1982, pp. 5-35.

25. "National Audubon Society vs. Superior Court", 33 Cal, Supreme 3-D, 5-4109; For a general discussion of the implications of public trust for resource management, see H.C. Dunning (ed.), The Public Trust Doctrine in Natural Resource Law and Management. School of Law, University of California, Davis, 1981.

26. See Note (10).

In reviewing the range of approaches previously discussed, and circumstance in the Hawaiian Islands, a number of conclusions seem evident.

i. The basic character of management decisions where developed value data might be utilized involves fishery resource enhancement and/or re-distribution. Consequently, compensatory estimation will not be a central concern for this analysis.

ii. Hawaiian Island residents live relatively close to their fishing, and utilize a variety of accessing points and facilities to seek out a variety of fish. Meyer Resources, Inc. concurs with SMS Research[27] that a travel cost based value simulation may not provide distinct product values and will likely provide a significant underestimate of the non-market value of resident fishing in Hawaii. Consequently, a direct simulation of resident fishing value is preferred.

We therefore concluded that key respondents should be asked to directly simulate a non-market value for resident fishing.

b) Framing the Value Question

Boaters in the State of Hawaii enjoy a strong tradition of free public access to fisheries--and there is no sport fish license in the state. To ask what fishermen would be "willing to pay" for a given increment of fishing is totally foreign to existing circumstance in Hawaii--and could confidently be predicted to result in major levels of non-compliance, both with that question and with our other enquiries. Equally important, results from such a "willingness to pay" approach would be meaningless to any real Hawaii context. We therefore needed to develop a question framing approach that was more consistent with Hawaiian Island circumstance. Kahneman and Tversky have noted that symmetry between question framing and

---

27. SMS Research, op. cit.

the valuing context that respondents consider appropriate is potentially important to a reliable contingent value response[28].

In attempting to develop more appropriately framed non-market valuation procedures, and to deal with the economist's concern that willingness to pay (WTP) questions produce biased underestimates while willingness to sell (WTS) questions produce biased overestimates[29], we discovered in previous work that if questions were framed to seek a "fair value", responses fall between the WTP and WTS extremes[30]. The theoretical implications of introducing an equity concept such as fairness--virtually ignored until recently by economists--are still being developed. Baumol, in a major recent work, provides important insight for a theory of fairness, and "fairness improvement", and relates his findings to the Pareto improvement theory of more conventional economics[31]. Thaler notes that the perceived "merits" or "demerits" of a transaction will increase/decrease total utility, and goes on to indicate that the most important determinant of a "just

---

28. Kahneman, Daniel and A. Tversky, "Prospect Theory: An Analysis of Decision Under Risk", Econometrica, March, 1979, 263-291.

29. Bishop, Richard C. and T.A. Heberlein, "Measuring Values of Extra-Market Goods: Are Indirect Measures Biased?" American Journal of Agricultural Economics, 1979, Vol. 61, no. 5, 926-930.

30. Meyer Resources, Inc. "Values for Fish, Wildlife and Riparian Resources", in Economic Evaluation of River Projects. A Report to the California Resources Agency, 1982. Vol. III.

31. Baumol, William J. Superfairness. The MIT Press, Cambridge, Mass, 1986.

price" is fairness[32]. Brown argues that assigned values ar function of fundamental or "held" values (in which "honesty" pl a large role), preferences and social relationships[33]. Under t line of reasoning, a theory that deals only with unconstrai personal preferences will be incomplete. Finally, Kahneman, Knet and Thaler identify circumstances where opportunity for retaliat based on concepts of "what is fair" apparently constrain t actions of firms operating in real markets[34]. Consistent with t developing theory, with empirical evidence that concepts fairness dampen bias from unconstrained willingness to p questioning, and with actual circumstances experienced by Hawaii fishermen, it was consequently decided that inquiry as to a "fa non-market value" for fishing had the best chance of simulati actual assigned values, to use Brown's term (Note 33), that wou occur in a real market.

c) Specifying the Fishing Product

Simulation of non-market economic value for fisheries ca specify a range of "products" to be valued--a fish, an hour o fishing, a recreation day, a trip, a month's recreation, a year' recreation, and so on. Because the present analysis targete marginal effects of fisheries management, it was clear that relatively small product size was most appropriate.

---

32. Thaler, Richard, "Mental Accounting and Consumer Choice", Marketing Science, Summer, 1985, 4:3, 199-214.

33. Brown, Thomas C. "The Concept of Value in Resource Allocation". Land Economics, August, 1984, 60:3, 231-246.

34. Kahneman, Daniel, Jack L. Knetsch and Richard Thaler, "Fairness as a Constraint on Profit Seeking: Entitlements in the Market", American Economic Review, Vol. 76, no. 4, pp. 728-741.

d) Making Non-Market Valuation Understandable

Discussants often find the concept of non-market value novel, and it is desirable to anchor their response in some context that is familiar to them. Considering this issue, key respondents were encouraged to first consider what they could obtain in the market for one hour of work (ie. their wage). They could then use that number as a reference point in developing a value estimate for an hour of fishing.

e) The Actual Question

Referencing the issues just discussed, the following two step inquiry was put to key respondents.

> Some fishermen place a value on fishing over and above what they spend on it--and dollars are often used to measure this additional value, even though it's a personal value for the fisherman, and is not bought, sold or charged for.
>
> If we are to properly and fully value sport fishing activities, we need you best estimate in dollars of this additional value. To help you think of these benefits in dollar terms, you might think of what your sport fishing time is worth to you. Do you value your fishing time at the same level you get paid for your time when you work? Is it worth more to you? Is it worth less?
>
> Now, on the kind of trip you take most often, what value, if any, over and above actual trip costs, would you associate with an hour of fishing? _____ $/hr.
>
> Fair value for an hour of boat fishing _____

In sum, simulation of non-market values for fishing is complex. We believe that considering the need to fit enquiry to the circumstances of Hawaii's resident fishermen, and foregoing conceptual discussion, the non-market value results reported in the next section for Hawaii's fishermen are reasonable. Further, given their relative symmetry, on an island by island basis, it is not clear that means would change significantly in a formal randomized survey, although variances would likely decline.

Finally, we also sought marginal values, by asking key respondents who indicated an average value for a hour of fishing, to then indicate how that value would change if catch was reduced to half current levels.

f) Non-Market Values for Resident Boat Fishermen in the Hawaiian Islands

i) Average Values for Resident Boat Fishermen

Based on discussion with key respondents and our follow-up procedure, the following information is considered representative of the non-market values that members of boat fishing clubs in the Hawaiian Islands associate with their fishing. To the extent that key respondents were unable to articulate cultural or commercial lifestyle values in dollar terms, they may not be complete. Table 8 presents a frequency distribution of non-market values associated with an hour's boat fishing by resident respondents.

Table 8

Frequency Distribution of Non-Market Values Associated with Boat Fishing by Hawaiian Residents

Non-Market Value in Dollars/Hour	Number of Observations
0	6
1	4
2	5
3	1
4	2
5	9
6	2
7	3
8	3
9	2
10	27
12	2
14	2
15	14
20	10
21	1
25	13
28	1
30	9
40	2
50	9
75	1
100	3
200	1
Total Observations	132

It can be observed that Table 8 has a modal value of $10 per hour, and a median value of $14 per hour. The distribution is slightly skewed to the right. In Table 9, information on hourly earnings and non-market value for resident boat fishing are presented, by club, island and state. Earnings are not provided by individual club for reasons of privacy.

Table 9

Earnings and Non-Market Values for Resident Boat Fishermen in the Hawaiian Islands

Area/Club	Average Earnings per Person $/hr.	Average Non-Market Value Per Person $/hr.	Standard Deviation of Non-Market Value $/hr.
State of Hawaii	19.89	20.08	19.11
Oahu	22.22	20.28	--
Aiea	--	10.83	3.76
Haleiwa	--	21.00	7.79
Honolulu Mosquitos	--	18.69	17.08
Kaneohe	--	27.86	32.10
Keehi	--	17.82	14.89
Pearl Harbor	--	15.00	6.12
Waialua	--	24.72	26.90
Big Island	16.97	23.00	--
Hilo Trollers	--	25.27	40.97
Kona Mauka	--	17.71	11.18
Maui	24.90	22.08	--
Maalaea	--	22.08	261.64
Maui Coop(1)	--	11.67	5.77
Kauai	13.08	7.30	--
Kukuiula	--	5.50	3.11
Westside	--	8.50	8.78

(1) Maui Coop is primarily interested in commercial fishing.